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(56) Documents Cited

GB 2368893 A

GB 2190978 A

EP '0083451 A

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(58) Field of Search

UK CL (Edition T ) F2U U12

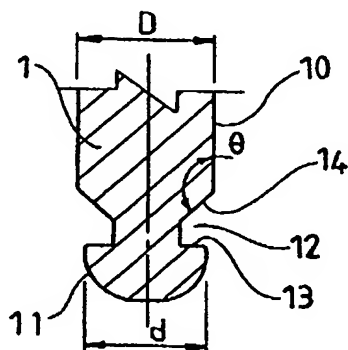
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(54) Abstract Title

**Shaft retaining notch**

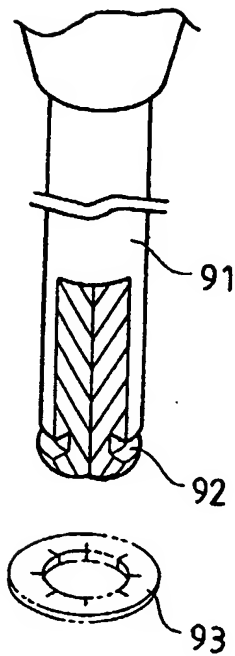
(57) A rotor shaft 1 comprises an end fixed to a base (2 Fig. 3) of a rotor and includes a distal end having dome 11 and engaging groove 12 for a 'C' clip or washer. The groove is annular and defined by lower 13 and upper 14 walls. The upper wall either comprises, or is connected with the outer periphery of the rotor shaft by, an inclined section (e.g. chamfer) or a round (15 Fig. 7). The inclined section takes an obtuse angle  $\theta$  of 100-135° with the periphery of the shaft. The dome diameter  $d$  may be smaller than the shaft diameter  $D$ . The lower wall may also comprise a chamfer or a round. The 'C' clip or washer may retain a bearing (94 Fig. 2) on the shaft and the chamfers or rounds reduce scratching when the shaft is inserted into a bearing of soft material.



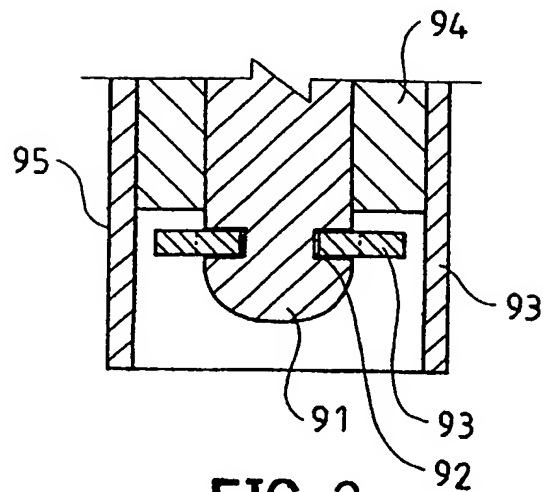
**FIG. 4**

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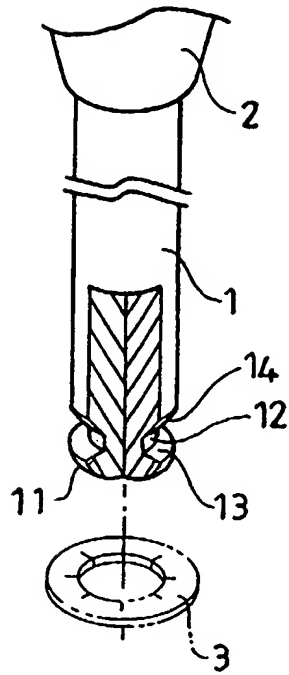


**FIG. 1**  
**PRIOR ART**

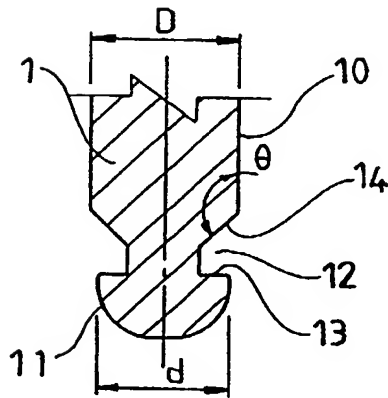


**FIG. 2**  
**PRIOR ART**

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**FIG. 3**



**FIG. 4**

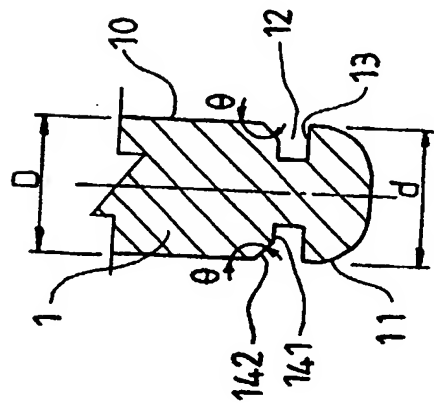


FIG. 5

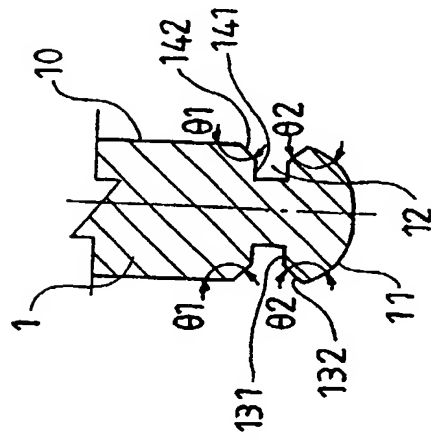


FIG. 6

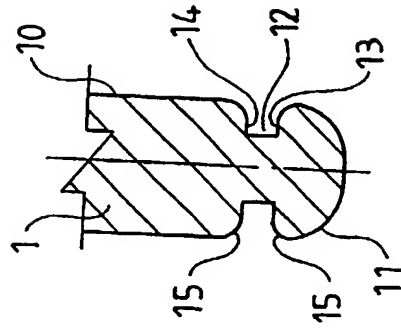


FIG. 7

## Rotor Shafts

### Background of the Invention

#### 1. Field of the Invention

The present invention relates to rotor shafts for preventing the bearings for the rotor shafts being scratched during assembly or detachment.

#### 2. Description of the Related Art

Fig. 1 shows a conventional rotor shaft and Fig. 2 shows an axle tube for receiving the rotor shaft. As illustrated in Fig. 1, the rotor shaft 91 includes an engaging groove 92 in a distal end thereof for engaging with a washer 92 to thereby prevent disengagement of a bearing that rotatably receives the rotor shaft 91 and that is received in the axle tube 95. Thus, the rotor shaft 91 is rotatably mounted in the axle tube 94.

Nevertheless, the engaging groove 92 of the rotor shaft 91 includes a wall surface that is substantially perpendicular to an outer periphery of the rotor shaft 91. When mounting the rotor shaft 91, the bearing 94 is firstly engaged in the axle tube 95 and the rotor shaft 91 is extended through a longitudinal hole 96 of the bearing 94. Another method for mounting the rotor shaft 91 is firstly inserting the rotor shaft 91 through the longitudinal hole 96 of the bearing 94 and then fixing the bearing 94 inside the axle tube 95. In either case, the wall surface of the engaging groove 91 more or less scratches the inner periphery of the longitudinal hole 96 of the bearing 94. The problem is aggravated if it is required to pull the rotor shaft 91 out of the bearing 94 and re-insert it into the bearing 94 or if the bearing 94 is a copper bearing, oily bearing, or self-lubricating bearing that is made from softer material.

### Summary of the Invention

It is the primary object of the present invention to provide a rotor shaft that will not damage the inner periphery of the longitudinal hole of the bearing during assembly.

A rotor shaft in accordance with the present invention comprises an end fixed to a base of a rotor. The rotor shaft further includes a distal end having a dome and an engaging groove. The engaging groove is annular and defined by a lower wall and an upper wall. At least one of

1 the lower wall and the upper wall is connected with the outer periphery of the rotor shaft by an  
2 inclined section or a round. The inclined section is at an obtuse angle with the outer periphery  
3 of the rotor shaft.

4 Other objects, specific advantages, and novel features of the invention will become  
5 more apparent from the following detailed description and preferable embodiments when  
6 taken in conjunction with the accompanying drawings.

### 7 **Brief Description of the Drawings**

8 Fig. 1 is a perspective view of a conventional rotor shaft.

9 Fig. 2 is a schematic sectional view of the conventional rotor shaft and an axle tube for  
10 receiving the conventional rotor shaft.

11 Fig. 3 is a perspective view, partly cutaway, of a first embodiment of a rotor shaft in  
12 accordance with the present invention.

13 Fig. 4 is a partial sectional view of the rotor shaft in Fig. 3.

14 Fig. 5 is a partial sectional view of a second embodiment of the rotor shaft in  
15 accordance with the present invention.

16 Fig. 6 is a partial sectional view of a third embodiment of the rotor shaft in accordance  
17 with the present invention.

18 Fig. 7 is a partial sectional view of a fourth embodiment of the rotor shaft in accordance  
19 with the present invention.

### 20 **Detailed Description of the Preferred Embodiments**

21 Referring to Figs. 3 and 4, a first embodiment of a rotor shaft in accordance with the  
22 present invention generally includes an end fixed to a base 2 of a rotor (not shown). The other  
23 (distal) end of the rotor shaft 1 includes a dome 11. Defined in the rotor shaft 1 and adjacent to  
24 the distal end is an engaging groove 12. In this embodiment, the engaging groove 12 is an  
25 annular groove defined in an outer periphery of the rotor shaft 1.

26 The engaging groove 12 is defined by a lower wall 13 and an upper wall 14. The lower  
27 wall 13 is located on a plane that is substantially perpendicular to a longitudinal axis of the

1 rotor shaft 1. When a fastener 3 (such as a C-clip or a washer) is engaged in the engaging  
2 groove 12, the fastener 3 abuts against the lower wall 13 to prevent disengagement of the  
3 fastener 3. In this embodiment, preferably, the lower wall 13 has an outer diameter "d" that is  
4 smaller than a diameter "D" of the rotor shaft 1.

5 As illustrated in Fig. 4, the upper wall 14 has an angle  $\theta$  with an outer periphery of  
6 the rotor shaft 1. This angle  $\theta$  is obtuse and is preferably  $100^\circ$  -  $135^\circ$ . Thus, either  
7 mounting a bearing via the distal end of the rotor shaft 1 (or removing the former from the  
8 later) or inserting the rotor shaft 1 into the bearing (or removing the rotor shaft 1 from the  
9 bearing), scratching damage to the inner periphery defining the longitudinal hole of the  
10 bearing is minimized.

11 Fig. 5 illustrates a second embodiment of the rotor shaft 1, wherein the upper wall 14 of  
12 the engaging groove 12 includes a horizontal section 141 that is substantially perpendicular to  
13 the longitudinal axis of the rotor shaft 1. The upper wall 14 of the engaging groove 12 further  
14 includes an inclined section 142 that extends outward and upward from the horizontal section  
15 141 and that has an obtuse angle  $\theta$  with the outer periphery of the rotor shaft 1. The obtuse  
16 angle  $\theta$  is preferably  $100^\circ$  -  $135^\circ$ . Preferably, the distal end of the rotor shaft 1 includes a  
17 dome 11 and the lower wall 13 has an outer diameter "d" that is smaller than a diameter "D"  
18 of the rotor shaft 1.

19 Fig. 6 illustrates a third embodiment of the rotor shaft 1, wherein the lower wall 13 of  
20 the engaging groove 12 includes a horizontal section 131 that is substantially perpendicular to  
21 the longitudinal axis of the rotor shaft 1. The lower wall 13 of the engaging groove 12 further  
22 includes an inclined section 132 that extends outward and downward from the horizontal  
23 section 131 and that has an obtuse angle  $\theta_2$  with the outer periphery of the rotor shaft 1. The  
24 obtuse angle  $\theta_2$  is preferably  $100^\circ$  -  $135^\circ$ . In addition, the upper wall 14 of the engaging  
25 groove 12 includes a horizontal section 141 that is substantially perpendicular to the  
26 longitudinal axis of the rotor shaft 1. The upper wall 14 of the engaging groove 12 further  
27 includes an inclined section 142 that extends outward and upward from the horizontal section

1 141 and that has an obtuse angle  $\theta_1$  with the outer periphery of the rotor shaft 1. The obtuse  
2 angle  $\theta_1$  is preferably  $100^\circ - 135^\circ$ . Preferably, the distal end of the rotor shaft 1 includes a  
3 dome 11 and the lower wall 13 has an outer diameter "d" that is smaller than a diameter "D"  
4 of the rotor shaft 1.

5 Fig. 7 illustrates a fourth embodiment of the rotor shaft 1, wherein the engaging groove  
6 12 is defined by a lower wall 13 and an upper wall 14. Each of the lower wall 13 and the upper  
7 wall 14 is connected with the outer periphery of the rotor shaft 1 by a round 15. The distal end  
8 of the rotor shaft 1 includes a dome 11.

9 According to the above description, it is appreciated that the engaging groove 12 of the  
10 rotor shaft 1 includes a lower wall 13 having a horizontal section 131 against which a fastener  
11 abuts, thereby preventing disengagement of the fastener 3 that is received in the engaging  
12 groove 12. The upper wall 14 of the engaging groove 12 is either at an obtuse angle with the  
13 outer periphery of the rotor shaft 1 or connected with the outer periphery of the rotor shaft 1  
14 by a round 15. The lower wall 13 of the engaging groove 12 is either at an obtuse angle with  
15 the outer periphery of the rotor shaft 1 or connected with the outer periphery of the rotor shaft  
16 1 by a round 15. In addition, the outer diameter "d" of the lower wall 13 is smaller than the  
17 diameter "D" of the rotor shaft 1. As a result, either mounting a bearing via the distal end of  
18 the rotor shaft 1 (or removing the former from the later) or inserting the rotor shaft 1 into the  
19 bearing (or removing the rotor shaft 1 from the bearing), scratching damage to the inner  
20 periphery defining the longitudinal hole of the bearing is minimized. Longevity of the motor  
21 using the rotor shaft in accordance with the present invention is prolonged.

22 Although the invention has been explained in relation to its preferred embodiment as  
23 mentioned above, it is to be understood that many other possible modifications and variations  
24 can be made without departing from the scope of the invention. It is, therefore, contemplated  
25 that the appended claims will cover such modifications and variations that fall within the true  
26 scope of the invention.



**What is claimed is:**

1. A rotor shaft comprising an end adapted to be fixed to a base 2 of a rotor, the rotor shaft 1 further including a distal end having a dome 11 and an engaging groove 12, the engaging groove 12 being annular and defined by a lower wall 13 and an upper wall 14, the upper wall 14 including an inclined section 142 that is at an obtuse angle with an outer periphery of the rotor shaft 1.
2. The rotor shaft as claimed in claim 1, wherein the obtuse angle between the inclined section 142 of the upper wall 13 and the outer periphery of the rotor shaft 1 is  $100^{\circ}$  -  $135^{\circ}$  .
3. The rotor shaft as claimed in claim 1, wherein the lower wall 13 includes an inclined section 132 that is at an obtuse angle with the outer periphery of the rotor shaft 1.
4. The rotor shaft as claimed in claim 3, wherein the obtuse angle between the inclined section 132 of the lower wall 13 and the outer periphery of the rotor shaft 1 is  $100^{\circ}$  -  $135^{\circ}$  .
5. The rotor shaft as claimed in claim 1, wherein the lower wall 13 has an outer diameter d smaller than a diameter D of the rotor shaft 1.
6. The rotor shaft as claimed in claim 1, wherein the lower wall 13 is connected with the outer periphery of the rotor shaft 1 by a round 15.
7. A rotor shaft comprising an end adapted to be fixed to a base 2 of a rotor, the rotor shaft 1 further including a distal end having a dome 11 and an engaging groove 12, the engaging groove 12 being annular and defined by a lower wall 13 and an upper wall 14, the upper wall 14 being connected with an outer periphery of the rotor shaft 1 by a round 15.
8. The rotor shaft as claimed in claim 7, wherein the lower wall 13 includes an inclined section 132 that is at an obtuse angle with the outer periphery of the rotor shaft 1.
9. The rotor shaft as claimed in claim 8, wherein the obtuse angle between the inclined section 132 of the lower wall 13 and the outer periphery of the rotor shaft 1 is  $100^{\circ}$  -  $135^{\circ}$  .
10. The rotor shaft as claimed in claim 7, wherein the lower wall 13 has an outer diameter d smaller than a diameter D of the rotor shaft 1.

- 1 11. The rotor shaft as claimed in claim 7, wherein the lower wall is connected with the outer
- 2 periphery of the rotor shaft by a round.



INVESTOR IN PEOPLE

Application No: GB 0207733.7  
Claims searched: 1-11

Examiner: J. C. Barnes-Paddock  
Date of search: 14 August 2002

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): F2U (U12)

Int Cl (Ed.7): F16B21/16, 18; B60B37/10

Other: Online: WPI EPODOC PAJ

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB2368893 A (CHENG) See Figure 2. Shaft with cylindrical clip retaining groove having inclined proximal wall.	1,2,6-8
X	GB2190978 A (TANASHIN) See Figure 2. Shaft with cylindrical clip retaining groove having inclined proximal wall.	1,2,6-8
X	EP0083451 A (LEIFHEIT) See Figure 1. Shaft with clip retaining groove having inclined proximal wall.	1,2,6-8
X	US5704100 (FEDERAL HOFFMANN) See Figures 1 and 7. Clip arrangement with stepped, chamfered proximal groove wall of greater diameter than the distal wall.	1,2,5-7 10,11
X	FR2179377 A (ELTRO) See Figure 3. Clip notch with both walls chamfered.	1-4,6-9
A	US2822198 (GM) True domed fastener distal end.	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.